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ABSTRACT

This report details a method by which the cost of school building construction in Massachusetts could be substantially reduced. A special study committee concluded that a systems approach to school building would cut costs and produce buildings of better quality and greater flexibility. It recommended the creation of a Statewide corporation to oversee and finance school construction throughout the State while insuring continued local participation in planning and design. A related document is EA 004 073. (RA)

ERRATUM

Two steps were inadvertantly omitted from the list of Recommended Procedures for Constructing a School on Page 15

Following Step 15:

Dept. Ed. Approves preliminary plans.

Following Step 27:

Dept. Ed. Approves working drawings.

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Cover: Sixteenth century systems construction: The Orders of Vignola (Courtesy of The Boston Public Library)

SUMMARY REPORT

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A systems approach for Massachusetts schools

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A STUDY OF SCHOOL BUILDING COSTS FOR THE MASSACHUSETTS ADVISORY COUNCIL ON EDUCATION

by Campbell, Aldrich and Nulty, Boston

with Building Systems, Development, Inc., San Francisco; George J. Collins, Educational Associates, Inc., Boston; Mahoney McGrath Atwood & Goldings, Boston; McKee Berger Mansueto, Inc., Boston; F.S. Moseley and Co., Boston; SRS Consultants, Inc., Boston

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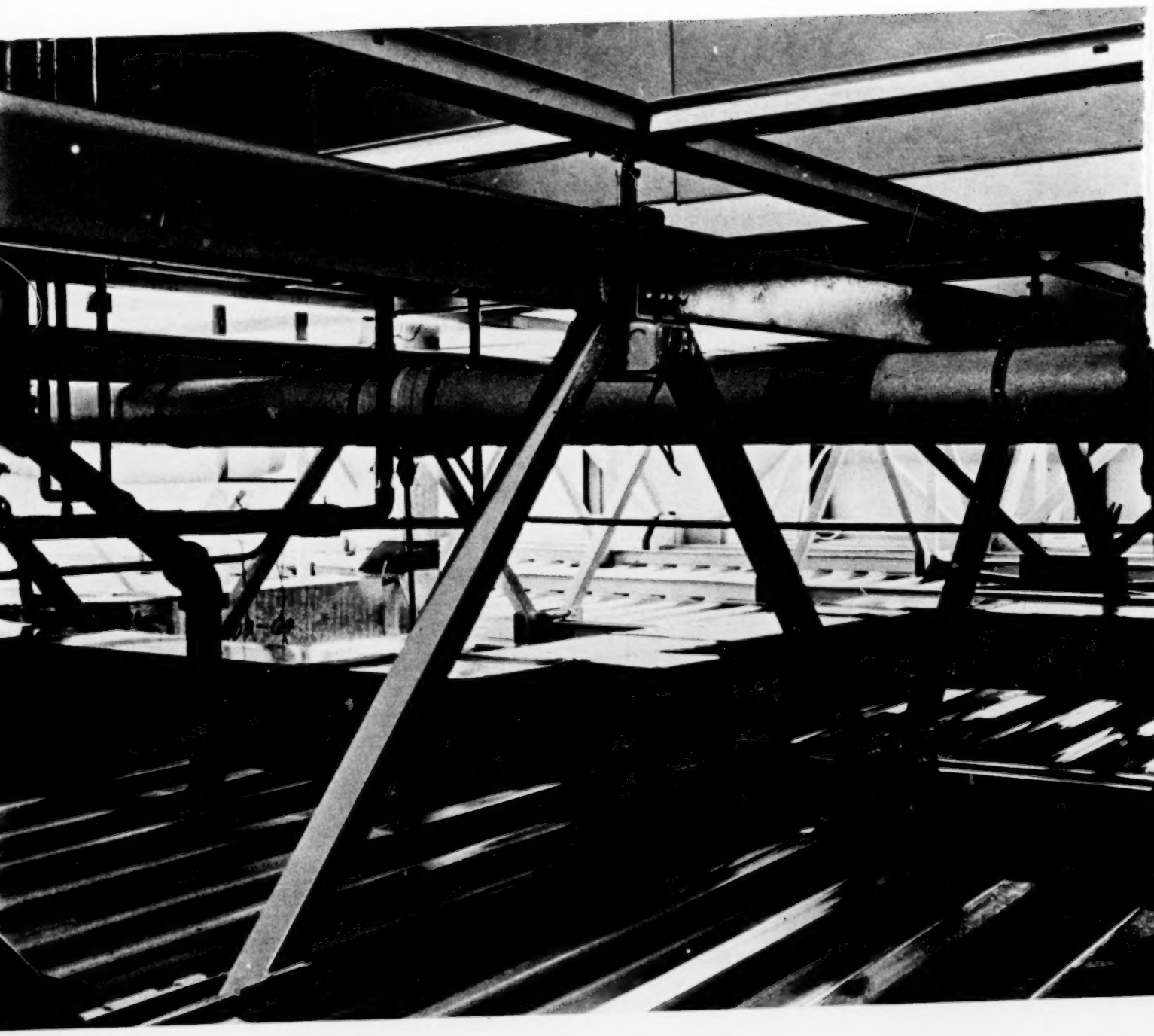
Summary Report prepared by Intelligence for Education, Inc. Paul Abramson, Editor

November, 1971



FOREWORD

Growth in population, modern technology and inflation have raised the economic costs of servicing and governing our complex society to an almost unbearable load. The leisurely, relatively simple, decentralized practices of the past do not respond to the opportunities of modern technology, and they are wasteful in responding to increasing demands and costs. Our public schools, spending $1.2 billion a year, are the State's biggest business—public or private. Providing housing for 1.1 million school students constitutes the State's largest single construction business, $150 million in 1971. On the conviction that people in Massachusetts and their leaders need to know what possibilities are available to them, and informed by the study of the Business Task Force for School Management that modern management practices and application of modern buildings systems could appreciably reduce the cost of our school buildings, the Advisory Council commissioned the study summarized in this volume. It engaged the noted architectural firm of Campbell, Aldrich and Nulty to assemble a team of experts in finance, law, r
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Heating, ventilating and air conditioning system

EWORD

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An examination of the analyses and recommendations of this study suggests an agenda to which the people and their leaders should give careful attention. On behalf of the Advisory Council and the Legislature which created it and funded it and the Governor who appointed it, we present this extensive and significant study and urge that it be given the consideration the dimensions of its subject require.

William C. Gaige
Director of Research

g, ventilating and air conditioning system

Introduction

School construction is an expensive business. Millions of dollars are spent each year on direct building costs of new elementary and secondary schools and on additions, major remodeling and modernization. In Massachusetts, the cost of school building now approaches $36 per square foot as compared to $19 per square foot just 10 years ago. The cost of land, fees and equipment is additional. (This is not unlike the experience of other states.) The total spent on new school construction alone exceeded $150 million in 1970 and reports indicate that vastly more space will be required in the next five years.

This report details a manner in which the cost of school construction in Massachusetts can be substantially reduced—perhaps by as much as 40%—while the quality of construction is increased and local planning and participation strengthened. Considering the current need for school construction, the desire of citizens to hold the line on taxes and the necessity to provide equal educational opportunity for children throughout the Commonwealth, the program presented here is one that demands immediate consideration and early action.

Formation of a study group

In June 1970, the Massachusetts Advisory Council on Education (MACE) commissioned the Boston architectural firm of Campbell, Aldrich and Nulty to assemble an interdisciplinary team to examine the school construction process in Massachusetts with an eye toward possible reductions in cost and increased efficiency. A particular emphasis of this study was to be the applicability of systems building—already being used in other parts of the Unit
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A team of experts representing a wide range of activities was assembled for the year long study.* In response to its charge, the study team put together a detailed picture of the existing school delivery process in the Commonwealth. Basic data was compiled on all school construction projects begun since mid-1965. The existing planning and approval process, building codes, state of building technology, labor markets, bidding and contract procedures and means of finance were all thoroughly investigated. The result was a comprehensive view of the present mechanisms by which a schoolhouse is built and a platform from which recommendations for change might be formulated.

This booklet summarizes the basic findings of the study team, explains its recommendations and presents the supportive material for the recommended steps. (The full 300-page report is available at college and university libraries throughout the State.) It is the hope of the study team that it will receive wide readership throughout the Commonwealth, and that it will become the basis for citizen discussion and executive and legislative action.

**For the names of the members of the study committee and the firms and activities they represent, see column at left.*

The need

During the next five years, school districts in Massachusetts will need more new classrooms than in any similar period in history. Contributing factors for this huge demand include presently overcrowded classrooms; current use of outmoded, below standard space; demands for new space caused by the creation of kindergarten programs in all districts; and shifting of students from non-public to public schools. An important additional factor is the inability of local municipalities and districts to keep up with expanding needs over the last few years. In large measure this has been due to taxpayer resistance to increases in an already overburdened property tax. Massachusetts has one of the highest property tax rates in the United States. Educational programs are largely dependent on this revenue.

Altogether, it is estimated that by 1975, 30 to 40 million square feet of instructional space will be needed, at a total cost exceeding $1.5 billion. When the cost of borrowing money is added, the total tax bill for Massachusetts would exceed $2.2 billion.

A great need for more classrooms

As the table on page seven shows, 10,700 instructional rooms must be provided by 1975. This does not include space for such activities as physical education, libraries, auditoriums and administrative needs. This sum was estimated by superintendents to be needed just to accommodate new students and overcrowding. In addition, up to 3,140 classrooms may be needed to accommodate transfers from non-public schools; and at least 1,500 to replace sub-par rooms, the majority of them in combustible buildings. As the table shows, the need is not confined to any one area of the Commonwealth. Nor is it needed later, rather than sooner. The greatest demand is indicated for the next three years.

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This is not the first time that Massachusetts has faced an immense school building task. In 1948, during the post-war period, the School Building Assistance Commission, a pioneering state agency, was formed to meet what was then seen as a temporary crisis. The life of SBAC was renewed five times over the next 18 years until, in 1966, it was merged into the State Education Department as the School Building Assistance Bureau. Given the limits—including a very low budget—placed upon its activities, the SBAC and SBAB have performed yeoman service for more than two decades. It has certainly been largely responsible for the high quality of schools built in the Commonwealth during that period. It is the belief of the study group, however, that new mechanisms must be provided to meet the new situation of the 1970's.

Role of SBAB since 1948

Estimating the needs of school construction is comparatively easy. Finding the resources and procedures to meet these needs is far more difficult. As the school construction program in the Commonwealth is now constituted, five major obstacles stand in the way:

OBSTACLE 1.

The tax base and voter resistance

Taxpayer resistance to new school construction is reaching a state of revolt. Over the past few years, a majority of the school bond referendums submitted to the electorate have been turned down. The effect is two-fold: Many children go through their full careers in inadequate, overcrowded buildings; and, when the building is finally approved, children and taxpayers get less building for more money.

Resistance to building leaves children in overcrowded schools

The burden of financing schools is not felt equally

throughout the State. The ability of local property owners to pay for new school facilities varies widely, frequently in inverse ratio to the need. Equality of educational facilities for all residents of the Commonwealth is simply not feasible when the major impact of school construction costs falls on an individual community. State construction aid provides some assistance, ranging between 40% and 65% of the cost of construction fees and equipment (but not land or interest payments), but inequality of local programs remains a fact of life. There is a need for a means of financing new school construction which will not put further strains on the unequal and inadequate local property tax.

Local tax base leads in inequality

OBSTACLE 2.

State laws and procedures that create delay and potential confusion and that lead to uneconomical building practices.

All new schools must be approved by the State Department of Education and other interested State agencies. (There are 13 different State departments, agencies, boards or divisions in Massachusetts issuing building regulations.) The State planning and approval process is cumbersome. Coupled with a lack of written standards, procedural handbooks or information service on facilities and comprehensive local and State requirements, it is no wonder that in meetings throughout the State several hundred persons told members of the study team that the building process is too long and should be shortened. (Altogether, the study team identified as many as 141 actions and procedures that districts could be required to go through in the process of bringing a building from recognition of need to opening. A few might reduce this number to 110 or 120, but too many must repeat the important initial steps.)

Approval practices create extra problems

While the procedures necessary to gain approval of a school building can at times be long, tedious and frustrating, other aspects of current State practice can also create problems. For example, the approval practices of the Department of Education and the Department of Public Safety result in per-pupil gr
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ment of Public Safety result in per-pupil gross areas that are often larger than those found in other states. Efficient buildings are not encouraged. The Commonwealth places no limit on the maximum per-pupil area or cost which can qualify for financial aid. As a result, some schools in Massachusetts have as little as 54% usable (or educational) space compared to their gross size. The median is 75%. Compact, well-planned schools with upwards of 85% educational space are reimbursed at the same rate as less economical ones.

School building regulations are written by the Board of Schoolhouse Structural Standards but are enforced by the Department of Public Safety, whose inspectors may have different interpretations of the regulations from those intended. Within the Department of Public Safety, different persons approve plans from those who inspect work in progress. Again differences in interpretation are likely to occur. These multiple jurisdictions result in loss of time, frustration and increased cost.

From the foregoing it is clear that if school construction in Massachusetts is to become less expensive and more efficient, steps must be taken to codify State procedures, to bring them into line with modern techniques, to give them flexibility to change with the times and to bring them together in such a way that they aid, rather than hinder, local school districts.

Procedural changes are needed for efficiency

OBSTACLE 3.

The state of the school construction industry

Although construction contracting is one of the largest industries in the United States—and education construction is the industry's dominant business in Massachusetts—it is largely composed of small companies. The multiplicity of subcontractors and suppliers involved in a typical school project serves to diffuse responsibility and to encourage buck passing. The result is time-loss, disputes over jobs and quality, frequent change orders and other procedures that add cost and delay completion. (Two-thirds of the

study's sample of recent schools were not completed on time, with the average delay running 35% to 40% of the agreed-upon time.)

Best contractor effort not being rewarded

Adding to the problem, there is nothing in the State bidding process to encourage extra effort on the part of the contractor. The selection of the contractor is dependent in effect on price alone and there is no feasible way to award superior performance. Thus a contractor who meets all of his schedules must compete on the basis of cost alone against contractors whose work is habitually long delayed.

School construction, as a process, is characterized by high costs, fragmentation of responsibility, inadequate cost and time control, wide fluctuations in the amount of work in progress, and seasonality. Clearly, for the sake of economy alone, some process must be implemented to overcome these shortcomings.

OBSTACLE 4.

The isolation of school districts and their lack of expertise in building

In Massachusetts, as in other states, the design and construction of public schools is a function of local municipalities and regional districts, which with consultants, plan and design each new facility, contract for construction, raise the basic funds to pay for it and operate it for the duration of its useful life. This local involvement is certainly a desirable procedure.

Long range planning too often neglected

But due in part to the press of more urgent matters and lack of funds, inadequate attention is given to long range planning and forecasting at the local level. As a result, the need for new school facilities is frequently allowed to become critical before the planning and design process is initiated. The result is that new buildings are not occupied until long after the need has become critical.

Beyond that, few communities maintain permanent

Estimate of Need for Addition Reported by Superintendents

	1971	1972
Metro	103	216
Elementary	56	5
Middle	24	107
Secondary	18	104
Occupational	5	—
Suburban	245	192
Elementary	48	77
Middle	13	10
Secondary	174	95
Occupational	10	10
Mid-east	316	443
Elementary	125	117
Middle	126	89
Secondary	39	198
Occupational	26	39
Northeast	319	349
Elementary	85	96
Middle	84	77
Secondary	119	155
Occupational	31	21
Southeast	575	453
Elementary	129	150
Middle	159	178
Secondary	272	103
Occupational	15	22
Western	575	360
Elementary	224	148
Middle	179	139
Secondary	163	58
Occupational	9	15
TOTAL	**2133**	**2013**

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Estimate of Need for Additional Instructional Rooms as Reported by Superintendents of Schools, 1971—1975

	1971	1972	1973	1974	1975	Total
Metro	103	216	930	202	178	1629
Elementary	56	5	254	202	178	695
Middle	24	107	236	—	—	367
Secondary	18	104	230	—	—	352
Occupational	5	—	210	—	—	215
Suburban	245	192	228	132	69	866
Elementary	48	77	86	48	26	285
Middle	13	10	66	27	11	127
Secondary	174	95	66	47	17	399
Occupational	10	10	10	10	15	55
Mid-east	316	443	739	320	299	2117
Elementary	125	117	247	96	75	660
Middle	126	89	154	23	94	486
Secondary	39	198	266	189	120	812
Occupational	26	39	72	12	10	159
Northeast	319	349	595	284	75	1622
Elementary	85	96	219	83	22	505
Middle	84	77	129	33	6	329
Secondary	119	155	206	139	34	653
Occupational	31	21	41	29	13	135
Southeast	575	453	768	303	405	2504
Elementary	129	150	230	110	176	795
Middle	159	178	185	86	137	745
Secondary	272	103	218	42	75	710
Occupational	15	22	135	65	17	254
Western	575	360	442	294	288	1959
Elementary	224	148	129	73	175	749
Middle	179	139	146	125	71	660
Secondary	163	58	125	59	34	439
Occupational	9	15	42	37	8	111
TOTAL	**2133**	**2013**	**3702**	**1535**	**1314**	**10,697**

Support needed for local planning effort

building committees. As a result, there is little carry-over of experience from one project to the next. Each building committee must learn its role anew—must rediscover the wheel—for each school building. It is apparent that some provisions must be made to establish and support permanent local building committees if local districts are going to be able to maintain direction of school construction planning to meet the needs of their students.

OBSTACLE 5.

The additional cost of interest payments and inflation

Interest payments can add as much as 60% to the cost of a new school over a 20-year period. So long as bonds are floated on a local basis, these costs will remain high. A system under which bonds could be supported by the State would reduce the cost of bonds by giving them a higher rating, by attracting large syndicates interested in purchasing them, and by making it possible to float bonds at times when the market is most favorable. This single change in current school building procedures would save millions of dollars for the citizens of the State.

Building costs doubling

Inflation is a more difficult cost to pinpoint, in that while costs rise, the tax dollar also becomes cheaper. Nevertheless, construction costs have been rising at an annual rate of approximately 12% (doubling in six years). Although there are indications of an imminent lessening to 7% (doubling in 10 years), it is obvious that any delay in the construction of a school not only deprives children but also is costly in purely monetary terms. Since most of the delays are procedural in nature (ranging from doing the necessary planning and passing the bond vote to gaining State approvals) it is apparent that steps can be taken to simplify the procedures and thus cut down on the time and dollar loss.

As can be seen, five major obstacles impede school construction practices in Massachusetts. recognized, however, that none of these insurmountable. As a matter of fact, each come through the use of systems and p ready in effect in many school construct across the nation.

The study team's survey of the state of struction in the Commonwealth led to fo conclusions:

1. *That there is an immediate need for scho tion.*

2. *That present procedures for school con lengthy, difficult, sometimes inefficient a drive the cost of construction up.*

3. *That fragmentation of both local proje construction industry creates a number including delay in building completion.*

4. *That there are steps that can be logic meet the State's building needs in a m manner.*

The next task was to outline those steps dures that would meet current needs an a mechanism that would make them work.

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construction practices in Massachusetts. It must be recognized, however, that none of these obstacles is insurmountable. As a matter of fact, each can be overcome through the use of systems and processes already in effect in many school construction projects across the nation.

Problems are obvious; solutions are possible

The study team's survey of the state of school construction in the Commonwealth led to four important conclusions:

1. *That there is an immediate need for school construction.*
2. *That present procedures for school construction are lengthy, difficult, sometimes inefficient and serve to drive the cost of construction up.*
3. *That fragmentation of both local projects and the construction industry creates a number of problems including delay in building completion.*
4. *That there are steps that can be logically taken to meet the State's building needs in a more efficient manner.*

The next task was to outline those steps and procedures that would meet current needs and to suggest a mechanism that would make them work.

A systems approach to building

Part of the charge to the study team was to investigate the applicability of systems building to the problems of Massachusetts.

In its essence, the systems approach to building is simply a working method which, instead of attempting to solve a complex problem piecemeal, approaches it in an orderly way by defining goals, analyzing means of achieving them and then carefully organizing the actual progress to a solution. As applied over the past decade to the construction of schools in California, metropolitan Toronto and elsewhere, the systems approach has yielded new ways of organizing the school delivery process which have resulted in systems construction: a series of components which may be assembled, rapidly and without cutting or fitting, into attractive, economical and flexible school buildings which are a better buy than conventionally constructed structures.

Increased quality, decreased cost

Systems building is not guaranteed to produce less expensive schools, although its use in many instances has resulted in lower construction costs than for conventional buildings. Systems construction produces buildings which incorporate more needed facilities and more flexible space for the same dollar. And because systems construction is much faster than traditional building, it allows new schools to be completed and to begin their use earlier at considerable savings in total project and peripheral costs.

As presently known in North America school building systems grew out of a single highly successful program known as School Construction Systems Development (SCSD), which was active in the early 1960's in California. About a dozen school districts agreed to cooperate, creating an "aggregated market" for building components. The market was sufficiently large to manufacturers in developing new products an ing existing ones for use by local architects in d individual schools. Performance specificatio lished what was expected of the componen leaving open the means by which the performa achieved. This was the first time in the con industry in this country that groups of manu came together to develop compatible compo that extent.

Since the completion of the SCSD program th been a number of successful systems build grams throughout the United States and Canad both developed new components and took a of existing ones—often called "off-shelf" com Many other schools throughout the United Sta made use of systems components. Readily coordinated building components now inclu ture; heating, ventilating and air conditionin ment; integrated ceilings; electrical and electr tribution equipment; and interior partitions. T gether, these components can account for of the construction cost of a new school. Fur tems development could encompass as much of the school construction cost.

In effect, the use of systems components ext standardization already used in screw threa gauges, light bulbs and so on, to the scal building itself. The quality of designs poss systems components is, as with conventional b a function of the architect and his client.

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nents. The market was sufficiently large to interest manufacturers in developing new products and modifying existing ones for use by local architects in designing individual schools. Performance specifications established what was expected of the components while leaving open the means by which the performance was achieved. This was the first time in the construction industry in this country that groups of manufacturers came together to develop compatible components to that extent.

Since the completion of the SCSD program there have been a number of successful systems building programs throughout the United States and Canada, which both developed new components and took advantage of existing ones—often called "off-shelf" components. Many other schools throughout the United States have made use of systems components. Readily available coordinated building components now include structure; heating, ventilating and air conditioning equipment; integrated ceilings; electrical and electronic distribution equipment; and interior partitions. Taken together, these components can account for 40%-50% of the construction cost of a new school. Further systems development could encompass as much as 75% of the school construction cost.

In effect, the use of systems components extends the standardization already used in screw threads, metal gauges, light bulbs and so on, to the scale of the building itself. The quality of designs possible with systems components is, as with conventional buildings, a function of the architect and his client.

Systems building, not stock plans

The systems process should not be confused with stock plans. Stock plans standardize complete buildings. Building systems standardize only the component

pieces. These components may be utilized to create any plan that is needed to meet the needs of a particular school.

The most recent and best publicized attempt to use stock plans as a way to cut the cost of school buildings occurred in neighboring New York State. The plan proved unworkable and for all intents and purposes has been abandoned.

New York's stock plans were acceptable but uninspired designs. Architects were still faced with many design decisions. The plans could not respond sensitively to site conditions and precise student needs. There is a built-in tendency to obsolesence of techniques, materials and ideas, that, probably more than any other factor, prevents the widespread or successful use of stock plans. The systems approach does not suffer from this problem.

Systems components are no more or less inhibiting to a designer than standard door sizes, floor tiles or lighting fixtures. Since the architect is relieved of the necessity of forcing a collection of unrelated parts into some sort of a fit, he can devote more of his time and effort to apportioning space and creating an esthetically attractive environment for education.

Successful systems projects

Since SCSD, other systems projects have been undertaken successfully. The School Systems Project (SSP) of Florida simply took the SCSD components and utilized them on a mass scale in Florida. The result (see chart) has been a considerable reduction in school costs as well as a 45% saving in the time needed to design and construct a school building.

The Study of Educational Facilities (SEF) program in Toronto, Canada, was a major step forward. It went far beyond SCSD in many respects, generating a wide range of coordinated building products that will become available for general use on small projects as well as large ones. Among the systems components developed

by the SEF project are s
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plumbing, electric-electro
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Among the systems components developed

by the SEF project are structure, atmosphere, lighting/ceiling, interior space division, vertical skin, plumbing, electric-electronic distribution, roofing, carpet and casework. From the point of view of applicability to Massachusetts, the Toronto project—and another in Montreal—are particularly significant since they deal with climatic conditions more closely akin to those in the Commonwealth.

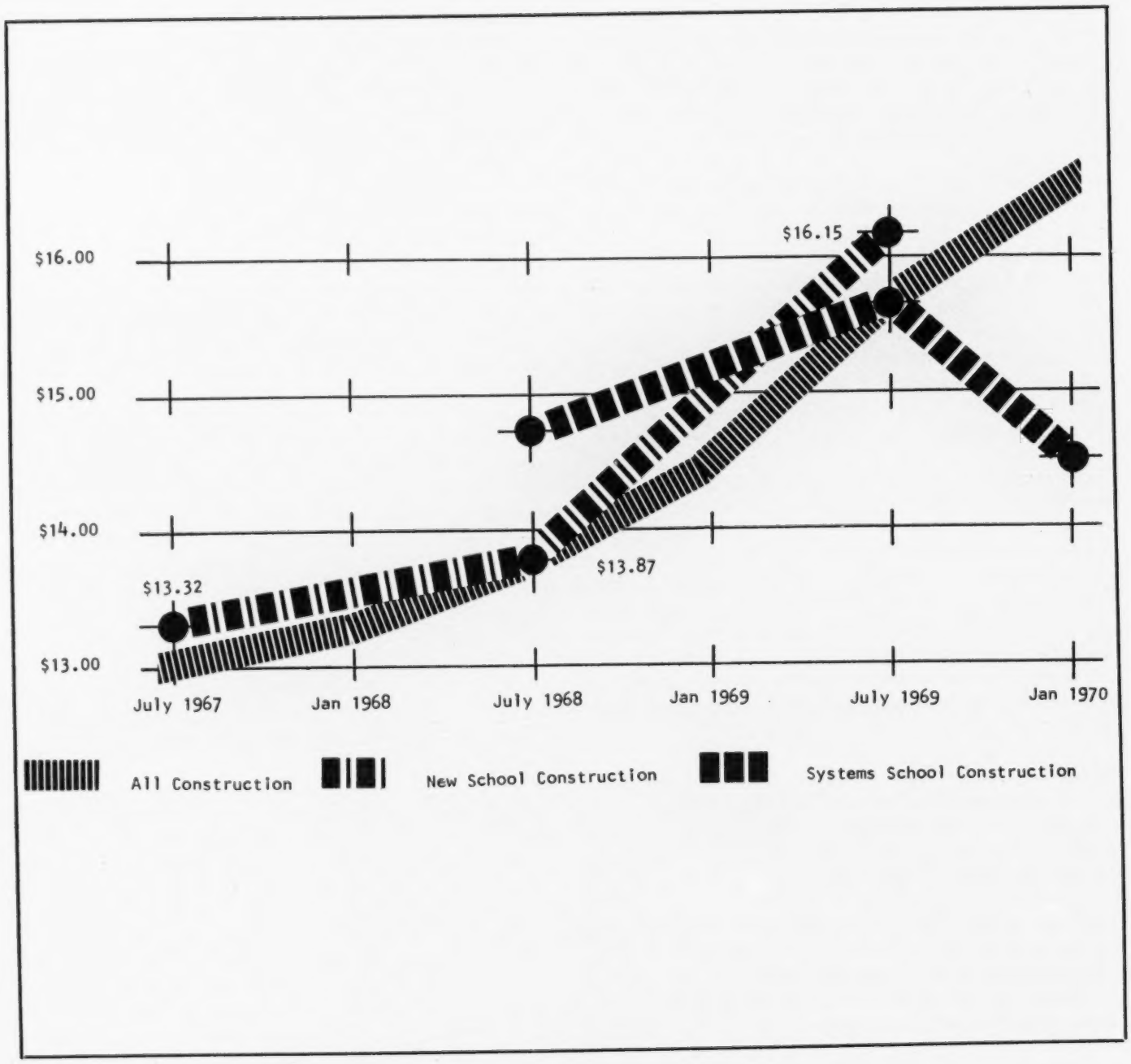
Another project of significance to Massachusetts is taking place in British Columbia where a School Building Authority has been created to coordinate the building efforts of 80 independent school districts and to make available to them the advantages of systems construction. The British Columbia plan will develop a large enough number of school projects to attract systems bidders. At the same time it will keep local school boards informed on new developments, so that when a project is contemplated, the board does not have to start from scratch. Participation in the British Columbia plan is voluntary but payment to local districts is based on their costs using the systems approach.

Savings in time and construction costs

Systems building brings order to the near chaos of the present school construction process. It results in savings in time in the design and construction phases of a school project. It results in savings in construction costs. It results, too, in higher quality school buildings flexible enough to meet educational program changes. This is a point that must not be overlooked.

Importance of performance specifications

One key to the development of systems building has been the use of performance specifications. This has led to important modifications in many components. For example, it is not enough for a heating, ventilating and air conditioning system to be compatible with other systems in the building or to provide a given amount of heating or cooling. Performance specifications in this case would also demand that the system be designed so that it puts no limitation on how the interior of a building may be sub-divided. This performance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specification gives schools considerable extra flexibility and increases their long term usability. By the same token, since the specifications don't tell the manufacturer the methods or materials he must use, he has more flexibility in finding economical solutions to the performance demanded. Performance specification is a tool for achieving higher quality in school buildings.

The existence of a number of schools using systems components clearly establishes that it is possible, feasible and economical to use systems building to construct schools in Massachusetts. These schools, however, although they use systems components, have been bid and contracted for in a conventional manner and not without considerable legal question surrounding such practice. In order to secure the full advantages of a systems approach to school construction on a statewide basis, various modifications must be made to the existing bidding system.

Modifications needed in present laws

For example, the present bidding law of the Commonwealth makes difficult the specifying of components by the performance required of them rather than by the materials and methods to be used. The statutory categories of filed sub-bids are not well-suited to systems components. (Some recent projects by temporary exception to the law have been successfully bid using, for instance, a single sub-bid for "integrated ceiling," rather than splitting that component, as required by law, into its electrical, acoustical tile, heating and other parts.)

Pre-qualifying bidders

Prequalification of bidders, felt to be an indispensible part of developmental systems building programs, presently is illegal in Massachusetts. Staged bidding, either in the form of component pre-bidding or "fast-tracking," is cumbersome, although legal.

Building codes, while conservative and outdated in a few instances, present no major obstacle to the introduction of systems building, but the procedures involved in getting approvals defeat many of the advantages of systems construction.

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There are other areas of current State law and practice that would have to be modified or changed in order to make the advantages of systems building truly pay off for the people of the Commonwealth. But perhaps the most important step the State must take is to "aggregate a market" in order to make school construction in Massachusetts more attractive to potential systems component developers.

Aggregating a market

The concept of aggregating a market is a rather simple one. If an individual school district has a building program worth $3 million or even $10 million, in terms of national demand it has limited purchasing power. If a group of school districts can be put together and can agree to purchase systems components cooperatively, an "aggregated market" of several hundred million dollars can be created. The challenge is to develop a mechanism that will allow the State to aggregate a market in order to take full advantage of systems construction, without encroaching on the ability of local school districts to make local decisions about their own school curriculums and school construction projects. To be truly effective, such a mechanism would also have to in some manner speed the construction processes and relieve the pressure that school construction now puts on the local real estate tax.

Establishing a Massachusetts School Construction Corporation

The recommendations of the study committee were developed with several goals in mind. Among them:

- ☐ To provide equal educational opportunity for every child and teacher throughout the Commonwealth.
- ☐ To provide for the construction of school buildings at less than the current prevailing costs.
- ☐ To close the gap between the time when a new school is needed and when it is available for use.
- ☐ To accomplish those two goals with buildings of a quality which is equal or superior to schools currently being constructed.
- ☐ To provide a degree of relief to the property taxpayer by removing school construction costs and financing from dependence on the property tax.
- ☐ To accomplish that goal while insuring local participation in school planning and design.
- ☐ To encourage continuing improvement in the quality, economy and delivery time of new schools.
- ☐ To achieve all of these goals as rapidly as possible.

Two possible courses of action

The results of this study indicate that there are two courses of action by which these goals might be achieved. The first would essentially retain the existing administrative relationships but would revamp procedures through a process of legislation, administrative regulations and changes in daily practice. The second course of action would radically transform the school delivery process by transferring the active responsibility for constructing schools to the State through the creation of a Massachusetts School Construction Corporation (MSCC) which could take advantage of systems building and other cost and time savers. *The second course of action will achi goals and is the recommendation o*

The establishment of a Massachu struction Corporation would autom a school construction market in th It would place the entire fiscal stru behind construction bonds. It would of school construction and financ roles. It would permit the State Depa to concentrate on educational ob would provide for planning and ap level. In short, the MSCC would m school districts throughout the Com their local school construction need quality buildings, at lower cost.

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Advantages of construction corporation

The establishment of a Massachusetts School Construction Corporation would automatically aggregate a school construction market in the Commonwealth. It would place the entire fiscal structure of the State behind construction bonds. It would remove the burden of school construction and financing from local tax roles. It would permit the State Department of Education to concentrate on educational objectives. Finally it would provide for planning and approval at the local level. In short, the MSCC would make it possible for school districts throughout the Commonwealth to meet their local school construction needs faster, with better quality buildings, at lower cost.

Better buildings at lower cost

While the other possible course of action (wholesale changes in present procedures and relationships, but retaining the basic school construction structure) might eventually accomplish some of the objectives, political reality suggests that such a road is not feasible. Too many unrelated pieces of legislation would be needed, too many vested interests, however legitimately they may be perceived by some, would be involved, too many present practices would have to be changed. The likelihood is that such an attempt would get bogged down and would either die or would be so long in development that it would not be ready when needed. Certainly such changes could not be implemented to meet the identified need for school housing between now and 1975.

The fundamental responsibility for public education in Massachusetts rests by Constitutional provision with

the State government. In truth, however, the provision of public education has been carried out at the local level with the State playing a supportive and largely reactive role. The strain which this has placed upon local resources is evidenced by the increasing reluctance of citizens to tax themselves for needed school construction.

Obligation to provide equal educational opportunity

The study group's recommendation for a Massachusetts School Construction Corporation rests in the belief that the Commonwealth has a direct legal obligation to provide equal educational opportunity for every child of school age in the Commonwealth and that this obligation can only be met by shifting the responsibility for financing school construction from the local property tax to general State revenues. It must be emphasized that this shift is not intended to reduce meaningful participation by the local school authorities in the planning and operation of their schools but it is fair to say that under the construction corporation, the State's role as a reactive or passive partner would end.

Operation of MSCC

Working with local officials

The Massachusetts School Construction Corporation would be responsible for all public school construction within the Commonwealth. It would receive projections of five-year needs from local districts and use these to determine how much building it would finance and where. Local officials would select architects and would determine the curriculum and approve the design of the building in cooperation with the State Board of Education.

The MSCC would aggregate a market large enough to attract many potential suppliers of building components. In addition, it would have the resources to conduct its own research and development program relating to construction techniques, building materials, planning and cost data analysis. The MSCC would administer a new system of competitive bidding and would be responsible for the construction of school facilities and the purchase of compon construction.

It is proposed that legislation be adop the Massachusetts School Constructio a State agency within one of the ex offices under the present cabinet sys mendation is made as to the particula tariat in which this corporation should

All financing of school building project by the MSCC. The financial powers t new Corporation would enable it to the approval of the Governor and th notes and bonds backed by the full of the Commonwealth. Bond issues co large to attract nationwide syndicates, the Corporation to obtain the lowest interest available at any given time an the expense resulting from the cu issuing multiple bonds. (It is estimate will reduce current interest paymen State would provide the initial approp costs. Thereafter, money that is requi tion of MSCC (probably 2% to 3% of e the funding of projects would be deri of the construction cost savings m ments of principal and interest on th be made from the State's general rev

**Under legislation establishing the G authority exists during the next two through Executive Orders or by furth the ultimate placing of specific agenci siderations which should be weighed the following: (1) the planning functio would seem to appear to make it suited the Executive Office of Communities a the construction responsibilities would priateness of its placement within the Transportation and Construction; (3) t ject matter with which it deals results in being given to its placement within t of Educational Affairs.*

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facilities and the purchase of components for school construction.

It is proposed that legislation be adopted establishing the Massachusetts School Construction Corporation as a State agency within one of the existing executive offices under the present cabinet system. No recommendation is made as to the particular cabinet secretariat in which this corporation should be placed.*

Reducing interest costs

All financing of school building projects would be done by the MSCC. The financial powers to be granted the new Corporation would enable it to issue, subject to the approval of the Governor and the General Court, notes and bonds backed by the full faith and credit of the Commonwealth. Bond issues could be sufficiently large to attract nationwide syndicates, thereby enabling the Corporation to obtain the lowest possible rate of interest available at any given time and would eliminate the expense resulting from the current practice of issuing multiple bonds. (It is estimated that this alone will reduce current interest payments by 10%.) The State would provide the initial appropriation for startup costs. Thereafter, money that is required for the operation of MSCC (probably 2% to 3% of expenditures) and the funding of projects would be derived from a portion of the construction cost savings made. Annual payments of principal and interest on these bonds would be made from the State's general revenues.

**Under legislation establishing the Governor's cabinet, authority exists during the next two years for decisions through Executive Orders or by further legislation as to the ultimate placing of specific agencies. Among the considerations which should be weighed in this decision are the following: (1) the planning function of the corporation would seem to appear to make it suited for inclusion within the Executive Office of Communities and Development; (2) the construction responsibilities would indicate the appropriateness of its placement within the Executive Office of Transportation and Construction; (3) the educational subject matter with which it deals results in some consideration being given to its placement within the Executive Office of Educational Affairs.*

The local role

Under this plan local school districts retain jurisdiction over site selection, educational program, space requirements (consistent with State-established standards)* selection of an architect, approval of preliminary plans and working drawings. Thereafter the design, construction and funding of each school facility would be carried out by the Corporation. (See above for steps involved in an MSCC school building project.)

Local building committees

Each district would be required to establish a standing school building committee, made up of five members with overlapping three-year terms. This committee would have the following responsibilities:

□ To survey existing school facilities, prepare projec-

**Local districts will be permitted to exceed these standards and to pay for this increase from locally voted taxes or bond obligations.*

Recommended Procedures for Constructing a School Massachusetts School Construction Corporation

MSCC 1. notifies cities and towns to appoint School Building Committee (SBC)
2. notifies communities to:
   a. develop a comprehensive plan of existing school building facilities;
   b. project school building needs;
   c. develop a school land-use plan.

SBC 3. consults with Corporation, arranges for completion of surveys and obtains funding and contract approval.
4. submits surveys and plans to MSCC.

MSCC 5. approves comprehensive plan, survey and school land-use.
6. establishes priorities for construction based upon reports of needs.
7. selects, within appropriation from General Court the number of schools for construction.

SBC 8. obtains educational program and specifications.
9. selects and approves architect from prequalified list.
10. provides site.

MSCC 11. approves site.
12. establishes preliminary budgets for construction projects.

Dept. Ed. 13. approves educational specifications.

Arch. 14. prepares detailed preliminary plans (space requirements, exterior appearance, and site development).

SBC 15. approves preliminary plans.
16. submits preliminary plans to MSCC.

MSCC 17. reviews preliminary plans.

SBC 18. attends meeting with MSCC.

MSCC 19. approves preliminary plans.
20. aggregates market of schools.
21. prepares performance specifications for product purchase.
22. bids performance specifications.
23. accepts bids.
24. approves bids from manufacturers.

Arch. 25. prepares working drawings and specifications.
26. submits working drawings to MSCC.

MSCC 27. approves working drawings.
28. advertises for construction.
29. accepts bids.
30. awards contracts for construction.
31. approves contractor's payments recommended by the architect.
32. conducts field inspection.

SBC/ Arch. 33. orients staff to new school.
34. presents school facilities to School Committee.

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tions of school building needs, and to oversee the preparation of a comprehensive school land use plan. The costs of such planning would be funded by the corporation.

Local committees play key role

- ☐ To provide necessary sites.
- ☐ To obtain an educational program and space requirements for each specific school project.
- ☐ To select an architect.
- ☐ To approve preliminary plans and working drawings.
- ☐ To accept the completed school building on behalf of the local district.

Structure of MSCC

In order to provide an organization which is representative of, and responsive to, the educational interests of the State as a whole, the corporation's board of directors would be appointed by the Governor and be drawn from a variety of cities and towns from all parts of the State, with balanced representation of the major political parties and interest groups. The 15 members of the board would include members from the following categories:

Wide representation

I. *Cities*
One from a city over 500,000 in population;
One from a city between 100,000 and 500,000 in population;
One from a city less than 100,000 in population, none of whom would be from the same county.

II. *Towns*
One from a town within the metropolitan Boston area;
One from a town under 5,000 in population;
Two from other towns, none of whom would be from the same county.

III. *Professional members*
A superintendent of schools.
An educator.
An architect.
A person experienced in indus
management.
A person experienced in mu
nance.

IV. Two members from the publi
whom would be from the sam

V. The chairman of the State Bo

In order to insure that the function
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the chairman be designated fro
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   One from a town within the metropolitan Boston area;
   One from a town under 5,000 in population;
   Two from other towns, none of whom would be from the same county.

III. *Professional members*
   A superintendent of schools.
   An educator.
   An architect.
   A person experienced in industrial or construction management.
   A person experienced in municipal and state finance.

IV. Two members from the public at large neither of whom would be from the same county

V. The chairman of the State Board of Education

In order to insure that the functions of this board would be carried out free from political interests, not more than eight members would be of the same political party.

The members would serve without compensation but with reimbursement of expenses. It is proposed that the chairman be designated from time to time by the Governor, in order to maintain accountability in the office of the Governor for the standard of performance of the corporation. Other officers would be elected by members of the board in accordance with by-laws established by them.

The board of directors would appoint requisite professional staff and personnel and would be responsible for the achievement of the objectives of MSCC. The corporation would not be subject to the provisions of the Civil Service laws. The tasks to be performed by this agency require the highest degree of flexibility and competence, and they necessitate the offering of competitive salaries commensurate with those paid for comparable skills in the private sector.

Quality of staff

The corporation would be subject to audit by the State Auditor.

Role of the State Department of Education

The State Department of Education would retain its present functions relating to the establishment of mini-

Comparison of potential cost saving on school construction under different courses of action

(Note that figures in calculations are not what would be obtained from simply adding the savings, because successive savings must be calculated as a percent of a percent.)

	Savings through changes within existing framework		Savings thru Mass. School Construction Corporation		
			Initially		6-10 yrs. in future
	Probable	Maximum	Probable	Maximum	
Savings on construction cost per square foot					
Net savings through the Systems Construction Process:	5%	9%	13%	16%	20%
Systems Components & Installation					
Performance Specifications					
Prequalification of Bidders					
Project Management					
Phased Construction					
Less: Deduction for Administration of Program (2-3%)					
Volume Purchasing	1	3	6	6	6
Net Savings	6%	12%	18%	21%	25%
Savings from reduction of floor area					
Increased Planning Efficiency (reduction of gross: net ratio)	8%	10%	8%	10%	10%
Reduce Programmed Space Requirements	8	10	8	10	10
	15%	19%	15%	19%	19%
Combined savings of reduced cost per square foot and reduced floor area					
Cost per sq. ft. savings (from Table 1)	6%	12%	18%	21%	25%
Floor Area savings (from Table 2)	15	19	15	19	19
Combined savings on general contract	20%	29%	30%	36%	40%

Comparison of costs of three schools for the same number of students and the same educational requirements *Identification of need assumed to be in January 1971*

	Conventional school	Systems School built by th Estimated potential savings	Ma est s
Number of Pupils	750	750	
General Contract			
Cost per square foot (based on prices bid in 1971 for completion in 1973)	$36/s.f.	$30/s.f.	$2
Floor Area	100,000 s.f.	85,000 s.f.	81
Contract Price (for 1973 completion)	$3.6 million	$2.5 million	$2
Delay of completion beyond 1973	2 years	—0—	
Escalated Contract Cost	$4.2 million	$2.5 million	$2
Project Cost (i.e. includes land, equipment, fees, etc.)	$5.1 million	$3.4 million	$3
Interest Rate on Bonds	6%	5.5%	
Cumulative Total Debt Service Over 20 years	$8.3 million	$5.4 million	$4

mum standards for all public school buildings. It is proposed that the department be required to establish and promulgate minimum standards as binding regulations by mid-1972.

Role of other State departments

The Department of Public Safety would be allowed to disapprove the minimum standards promulgated by the Department of Education as they relate to areas within its jurisdiction. Any dispute between the two departments would be resolved by a special public hearing before a Board of School Building Standards, to be established as a part of the Department of Public Safety.

Public health

The Department of Public Health would retain its present powers and duties relating to the approval of health and sanitary requirements for sit public schools by local communities.

In sum, then, MSCC would be a Sta responsible for the construction of pub the Commonwealth. Local officials woul ble for planning, for acquiring sites and development and building design. Th would be responsible for funding schoo for aggregating a market, for bidding p for construction management. It would e would conduct research to further—the components in school construction, ta of all the economies this approach r chart on the preceding page indicates economies that could be provided by pared to any attempt to overhaul piec school construction practices.

Comparison of costs of three schools for the same number of students and the same educational requirements *Identification of need assumed to be in January 1971*

		Systems School built by the MSCC	
	Conventional school	**Estimated potential savings**	**Maximum estimate of savings**
Number of Pupils	750	750	750
General Contract			
Cost per square foot (based on prices bid in 1971 for completion in 1973)	$36/s.f.	$30/s.f.	$27/s.f.
Floor Area	100,000 s.f.	85,000 s.f.	81,000 s.f.
Contract Price (for 1973 completion)	$3.6 million	$2.5 million	$2.2 million
Delay of completion beyond 1973	2 years	—0—	—0—
Escalated Contract Cost	$4.2 million	$2.5 million	$2.2 million
Project Cost (i.e. includes land, equipment, fees, etc.)	$5.1 million	$3.4 million	$3.0 million
Interest Rate on Bonds	6%	5.5%	5.25%
Cumulative Total Debt Service Over 20 years	$8.3 million	$5.4 million	$4.6 million

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ealth The Department of Public Health would retain its present powers and duties relating to the approval of health and sanitary requirements for site selection for public schools by local communities.

A total approach to school construction

In sum, then, MSCC would be a State corporation responsible for the construction of public schools in the Commonwealth. Local officials would be responsible for planning, for acquiring sites and for curriculum development and building design. The corporation would be responsible for funding school construction, for aggregating a market, for bidding procedures and for construction management. It would encourage—and would conduct research to further—the use of systems components in school construction, taking advantage of all the economies this approach represents. The chart on the preceding page indicates the sum of the economies that could be provided by MSCC as compared to any attempt to overhaul, piecemeal, current school construction practices.

Conclusion

The charge

This study committee was formed for the purpose of examining the school construction process in Massachusetts, with particular emphasis on systems building. The objective was to find ways to reduce costs, increase efficiency and at the same time to guarantee high quality buildings. A fundamental premise of the entire study was the belief that the State must assume direct responsibility for providing equal educational opportunity for all children of the Commonwealth.

In essence, the study committee found the systems approach to school building applicable to Massachusetts. Moreover, it found that using such an approach could cut costs and result in buildings of better quality and greater flexibility.

The need

The study committee also found that there is a great need for school construction in the Commonwealth, but that local taxpayers are reluctant to add to the inflexible property tax in order to pay for them. In addition, it found that many current State procedures, laws, local ordinances and customs serve to slow building projects and to drive costs up.

The conclusion

It was these factors—plus the need to aggregate a market in order to take full advantage of the systems construction process—that led the study group to examine the advantages inherent in a Statewide corporation that would oversee and finance school construction throughout the State while insuring continued local participation in planning and design.

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